

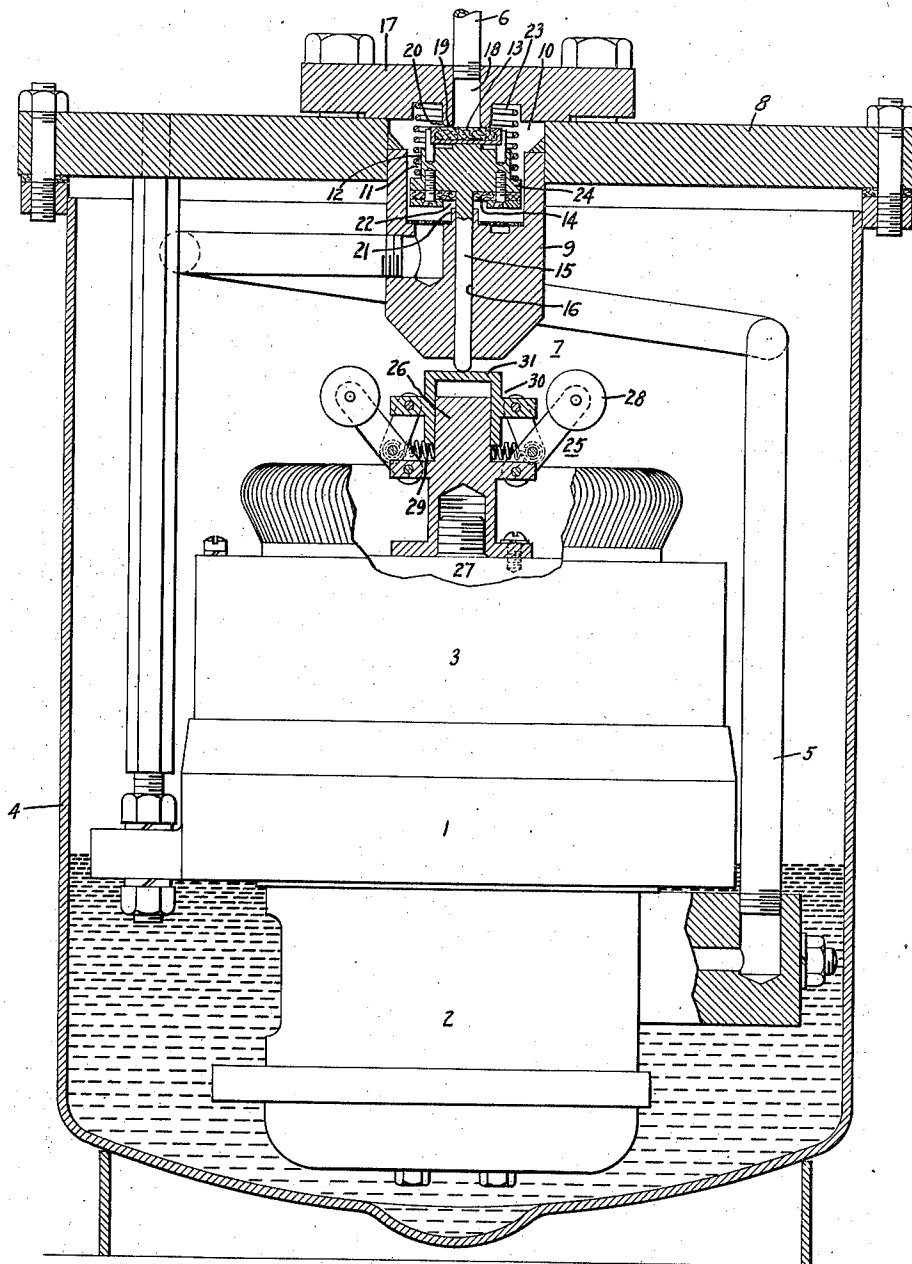
Aug. 19, 1941.

F. H. ANDERSON ET AL

2,253,159

VACUUM PUMP APPARATUS

Filed May 25, 1939



Inventors:
Frederick H. Anderson,
Ernest H. Lehman,
by *Harry C. Dunham*
Their Attorney.

UNITED STATES PATENT OFFICE

2,253,159

VACUUM PUMP APPARATUS

Frederick H. Anderson, Schenectady, and Ernest
H. Lehman, Scotia, N. Y., assignors to General
Electric Company, a corporation of New York

Application May 25, 1939, Serial No. 275,632

7 Claims. (Cl. 230—29)

Our invention relates to vacuum pump apparatus, particularly to roughing pump apparatus operating in connection with a high vacuum mercury condensation pump for evacuating mercury arc rectifiers or like devices of the metal tank type, and its general object is to provide a vacuum pump apparatus of this character which is of simplified and durable construction and of increased efficiency and reliability in operation.

A particular object of the invention is to provide, for the vacuum pump apparatus, a control apparatus comprising a valve device and automatically operated control means associated therewith so arranged that high starting torque usually required in operation of the vacuum pump, and difficulties due to creepage of oil from the pump into contact with valve members or due to creepage of oil into the vacuum chamber of the rectifier or like device, are obviated.

The pump apparatus in which our present invention has been embodied preferably includes an electrically driven pump mechanism which is essentially similar to pump mechanisms heretofore utilized as compressors for refrigerator apparatus. This pump mechanism is preferably vertically mounted, the rotary pump itself being submerged in an oil bath in a substantially sealed container and being driven by an electric motor mounted in the container and above the rotary pump. In the suction pipe leading from a point on the pump below the oil level to the exhaust pipe line of the rectifier is mounted a combined intake valve apparatus and relief valve apparatus, the combined apparatus being so arranged and controlled that when the pump is brought to a stop the intake valve is closed and, simultaneously, the relief valve is opened to admit air at atmospheric pressure into the suction pipe of the pump.

The relief valve remains open while the pump stands idle, thereby destroying the vacuum in the pump and pump suction pipe and preventing all possibility of creeping of oil or oil vapor into contact with the intake valve and into the vacuum chamber of the rectifier. Upon reenergizing of the pump motor the intake valve is held closed and the relief valve is held open for a predetermined time interval to admit air as above described to the pump and pump suction pipe. This time interval is sufficient to permit the pump to come up to substantially normal speed unloaded, thereby eliminating the high starting torque encountered when the pump is required to start against vacuum.

In Patent No. 2,124,390 to Frederick H. Ander-

son, assigned to the same assignee as the present application, a combined intake valve apparatus and relief valve apparatus for the oil-sealed rotary pump is disclosed which is mounted entirely outside of the pump and motor casing and which comprises a hollow valve stem, intake valve means and relief valve means at the opposite ends of the hollow stem, and a bellows member attached to the stem to give flexibility to the movement of the stem and to seal off the intake valve means from atmospheric pressure, the valve stem being actuated by a solenoid mechanism connected to the upper portion of the stem and also mounted outside of the pump and motor casing. In accordance with our present invention, for the purpose of connecting the pump to the suction pipe or to atmosphere, a control apparatus of few parts is provided, substantially all of which is mounted within the pump and motor casing and which comprises a simple, solid valve member operatively associated with a centrifugal control device mounted on the motor and pump unit.

The novel features which are considered to be characteristic of our invention are set forth with particularity in the appended claims. Our invention itself, however, both as to its organization and method of operation together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawing the single figure of which is a semi-diagrammatic cross-sectional view of a vacuum pump mechanism for an iron tank rectifier or the like, in which our invention has been embodied.

In the figure, the numeral 1 designates a motor and pump unit constituted by a vertically mounted rotary exhaust pump 2 driven by an electric motor 3 mounted thereabove. The pump and motor unit 1 is enclosed in a casing 4 normally filled with oil to such a height that the pump is totally submerged in the oil to prevent air or other gases from entering the pump and to seal the pump. Exhaust gases from the rectifier enter the pump through a pump suction pipe 5 and after passing through the pump and pump exhaust valve (not shown) into the casing 4 escape to atmosphere through an air port (not shown) in the casing. The motor is supplied with current from a suitable current source and a usual manual or other switch means (not shown) is provided to start and stop the pump.

To control the connection of the pump 2 to an exhaust line 6 which is adapted to be connected

to the vacuum chamber (not shown) of a device such as an iron tank rectifier, and to control the admission of air at atmospheric pressure to the pump, a control apparatus designated generally by the numeral 7 is provided substantially all of which is mounted within the casing 4 and between the pump and motor unit 1 and the upper surface of the cover plate 8 of the casing.

In the control apparatus 7 a valve supporting member 9 is provided which is connected to the casing cover 8, at an opening 10 formed there-through, and which extends downwardly therefrom. A vertically movable valve member 11 is mounted in the supporting member 9. The valve member 11 comprises a disk or cylindrical block portion 12 upon the upper and lower faces of which respectively are mounted valve faces 13 and 14 of rubber or other suitable material, and a stem portion 15 connected to or integral with disk 12 and freely slidable in the lower portion of support 9, the stem 15 extending downwardly through a hole 16 formed in the support. A cover member 17 for the opening 10 of cover plate 8 is provided having an exhaust opening 18 therethrough at which exhaust pipe 6 may be connected. A valve seat 19 adapted to cooperate with upper valve face 13 to constitute the pump intake valve, indicated by the numeral 20, is formed on the lower surface of cover member 17 at the opening 18, and a second valve seat 21 adapted to cooperate with lower valve face 14 to constitute the pump relief valve, indicated by the numeral 22, is formed within valve supporting or casing member 9 at the upper end of hole 16. A helical spring 23 mounted between cover member 17 and a flange 24 formed at the lower face of valve disk 12 normally biases the valve member 11 downwardly.

Vertical movement of the valve member 11 is controlled against the pressure of spring 23 by a centrifugal device 25, which comprises a weight supporting member or stud 26 mounted on the upper rotatable portion 27 of motor 3, weights 28 pivoted on supporting member 26, a spring means 29 biasing the weights 28 toward their closed position, and a bearing member 30 vertically slidable on stud 26 and having a top bearing plate or pressure plate 31 adapted to engage the lower end of valve stem 15. The centrifugal device 25 including spring means 29 is so arranged that as the weights 28 come to their idle or closed position, the upward pressure at plate 31 on valve member 11 through valve stem 15 due to spring means 29 is sufficient to overcome the downward pressure on member 11 due to its weight and the pressure of spring 23.

In operation of the vacuum pump apparatus hereinabove described, the pump and motor unit 1 is assumed to be initially at rest, the various parts being in the positions shown in the drawing. Since the intake valve 20 is in closed position the rectifier tank exhaust pipe 6 is maintained disconnected from pump suction pipe 5. The relief valve 22 being in open position, the clearance space between valve stem 15 and the wall of opening 16 of valve support member 9 provides a path for equalizing the pressure within the casing 4 and the pump exhaust pipe 5. When power current is supplied to the motor 3 the unit 1 is started into rotation and during a predetermined period thereafter accelerates up to normal speed. During this predetermined accelerating period the centrifugal device 25 is operated from its illustrated closed position to its open position, the arrangement and adjust-

ment of the centrifugal device and the valve means associated therewith preferably being such that the weights remain in their closed or illustrated position until the unit 1 has attained almost its full operating speed. The pump 2, therefore, runs idle during a large part of the accelerating period of the pump and motor unit since pump intake valve 20 remains in closed position during this part of the period thereby maintaining the pump suction pipe 5 cut off from communication with exhaust line 6, and relief valve 22 remains at the same time in open position thereby permitting air at atmosphere pressure or the pressure in casing 4 to pass up hole 16, through valve 22 into pump suction pipe 5, and through the pump back to casing 4. We have found that the period of time, determined by the acceleration time of the motor 3 and by the arrangement and adjustment of centrifugal device 25 and associated valve means 7, during which the pump 2 thus runs idle after its driving motor 3 is energized is sufficient to permit the clearing of all oil or foreign gases out of the pump and pump connections before normal operation begins.

When the pump and motor unit 1 attains a predetermined speed, preferably close to its full normal operating speed, the centrifugal device 25 suddenly assumes its open position, permitting pressure plate 31, valve stem 15 in contact therewith, and valve disk 12 to move downwardly under the pressure of valve spring 23. Since, when valve disk 12 thus suddenly drops to its lower position, intake valve 20 is caused to open and relief valve 22 is caused to close, the pump suction pipe 5 and pump 2 now become sealed from atmosphere or the air or gases in casing 4, and the pump pipe 5 and pump 2 become connected to exhaust line 6 for normal operation in exhausting the evacuated tank of the rectifier or other device to which exhaust line 6 is connected.

When the pump and motor unit 1 is deenergized after a period of operation, the centrifugal device 25 assumes its closed position after the unit has decelerated to a predetermined speed of rotation, the arrangement and adjustment of centrifugal device 25 and the associated valve device 7 being preferably such that this speed at which the device 25 suddenly assumes its closed position is but little below the full operating speed of the unit. As the device 25 assumes its open or central position pressure plate 31 is forced upwardly by the action of spring means 29 against the downward pressure of valve spring 23. Intake valve 20 is thus caused to close and relief valve 22 to open. Exhaust pipe 16 connected to the exhausted tank of the rectifier is cut off from pump suction pipe 5 and pump 2. Air at atmospheric pressure is admitted from casing 4 through relief valve 22 to the suction pipe 5. Therefore, the vacuum existing in the pipe, valve and pump parts during the previous period of operation is destroyed and creepage of oil from casing 4 or from pump 2 into contact with the valve parts in support 9, or creepage of the oil past the valve 20 into exhaust line 6 and thence to the evacuated chamber of the rectifier, is effectively prevented.

Upon further starting and stopping of the pump 2 the above described cycle of operations, including the period of idle running of the pump connected to atmosphere and cut off from the exhaust line 6, followed by the closing of the relief valve 22 and the opening of the intake

valve 20 between pump 2 and exhaust line 6, is repeated.

Our invention has been described herein in connection with a particular embodiment for purposes of illustration. It is to be understood, however, that the invention is susceptible of various changes and modifications and that by the appended claims we intend to cover any such modifications as fall within the true scope and spirit of our invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. Control apparatus adapted to connect selectively to an exhaust line and to atmosphere an exhaust pump having a driving motor operatively associated therewith, said control apparatus comprising a valve means having a valve to control the connection of said pump to said exhaust line and a second valve to control the connection of said pump to atmosphere, and a centrifugal device adapted to be rotated by said motor to operate said valves simultaneously.

2. Control apparatus adapted to connect selectively to an exhaust line and to atmosphere a pump unit enclosed in a casing and constituted by a rotary exhaust pump sealed by oil in said casing and a motor in driving relation with said pump, said control apparatus being enclosed substantially entirely within said casing and comprising a valve means having valves respectively to control the connection of said pump to said exhaust line and to atmosphere, and a centrifugal device operatively associated with said pump unit to operate said valves simultaneously.

3. Control apparatus adapted to connect selectively an exhaust pump to an exhaust line and to atmosphere, said apparatus comprising valve supporting means, a valve member mounted in movable relation therewith, means cooperating with opposite faces respectively of said valve member to form an exhaust valve between said pump and said exhaust line and to form a relief valve interposed between said pump and atmosphere, and a centrifugal device rotatable synchronously with said pump to control the movement of said valve member thereby to control the operation of said valves.

4. Apparatus adapted to control selectively the connection of a rotary exhaust pump to an exhaust line and to atmosphere, said apparatus comprising valve supporting means, a valve member mounted in slidable relation therewith, means cooperating with opposite faces of said valve member to form respectively an exhaust valve and a relief valve for said pump, a resilient means normally biasing said exhaust valve to open position and said relief valve to closed position, and

a centrifugal device rotatable synchronously with said pump and operatively associated with said valve member, said centrifugal device comprising a spring means adapted to close said exhaust valve and open said relief valve against the pressure of said resilient means when said pump is stopped.

5. Control apparatus for connecting selectively to an exhaust line and to atmosphere an exhaust pump having a driving motor operatively associated therewith, said control apparatus comprising a unitary valve means and a centrifugal device adapted to be rotated by said motor for operating said valve means to connect the suction side of said pump to said line and simultaneously to seal said suction side from atmosphere, and subsequently to seal said suction side from said line and simultaneously to connect said suction side to atmosphere.

6. Control apparatus for connecting selectively to an exhaust line and to atmosphere a pump unit enclosed in a casing and sealed by oil in said casing and having a suction pipe, said control apparatus comprising a unitary valve means and a centrifugal device operatively associated with said pump unit for operating said valve means to seal said suction pipe from said exhaust line and simultaneously to connect said suction pipe to atmosphere when the rotational speed of said centrifugal device drops below a predetermined limit thereby to clear oil from said unit and said valve means, and subsequently to connect said suction pipe to said exhaust line and simultaneously to seal said suction pipe from atmosphere when said rotational speed of said unit rises to approximately normal operating value.

7. Control apparatus for connecting selectively an exhaust pump to an exhaust line and to atmosphere, said apparatus comprising valve supporting means, a valve member mounted in movable relation therewith, means cooperating with opposite faces respectively of said valve member to form an exhaust valve between said pump and said exhaust line and to form a relief valve between said pump and atmosphere, and a centrifugal device rotatable synchronously with said pump for simultaneously closing said exhaust valve and opening said relief valve when the rotational speed of said centrifugal device drops below a predetermined limit, and subsequently for simultaneously opening said exhaust valve and closing said relief valve when said rotational speed rises to approximately normal operating value.

FREDERICK H. ANDERSON.
ERNEST H. LEHMAN.